Urodynamics

Uroflowmetry

Spinning disc or weight-based uroflow machines
Spinning disc susceptible to directional influences (wag artefact)
Must be above 150 mls to be worth interpreting
Second flow shown to be more representative of normal voiding
Males
- Uroflow may give an indication of likelihood of obstruction but not diagnostic (Reynard and Chapple)
  - >20 ml/s — Almost never obstructed
  - 15-20 ml/s — 30% obstructed
  - 10-14 ml/s — 60% obstructed
  - < 10ml/s — 90% obstructed
- Maximum flow age-dependent – declines by 1-2 ml/s every 5 years
- No specified 'abnormal' voiding time

Females
- Maximum flow typically > 25 ml/s
- Voiding time reduced cf. men

Cystometry

<u>Indications</u>
Prior to invasive Rx in SUI (see NICE guidelines)
Elderly males
Young males ~ 50 yrs
Children
Previous bladder outflow surgery
Flow > 15ml/s
Neuropaths
Low flow and suspected detrusor failure

<u>Contraindications</u>
Absolute
- UTI (postpone study)

Relative
- Indwelling catheter
- Pharmacotherapy for bladder dysfunction (stop 48 hours before)
- Known autonomic dysreflexia

<u>Technique</u>
Uroflowmetry and post-void residual
Filling phase
- Tilt table largely historical. No doubt that bladder overactivity may be missed when filling in supine position. Recommended that men are filled in standing position and women filled sitting (means that transducers need not be moved). Important to record 4 Cs:
  - Comfort
    - First sensation of bladder filling

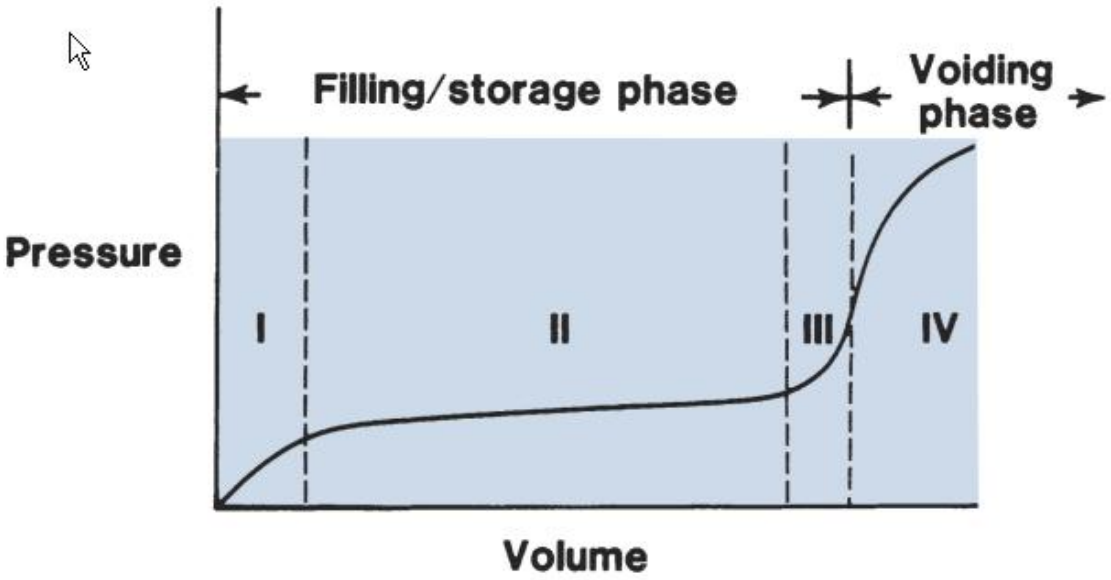
First desire to void
Strong desire to void

Contractions
- Any amplitude significant provided a/w symptoms
- Are they associated with urge symptoms
- Remember IDO vs. NDO

Compliance
- Change in volume per unit change in pressure
- No defined urodynamic value – Paul Abrams lower limit of normal 20-30ml/cm water (personal communication).
- Campbells quotes 1979 value of 12.5 ml/cm water
- NB. Law of Laplace: T = ½ Pressure x radius

Capacity
- Empty PVR at time of catheterisation unless low compliance suspected (useful rule of thumb ~40% functional bladder capacity/voided volume – Chris Chapple))

Filling phase historically described as having 4 phases:
1. initial fill (unfolding, viscoelastic)
2. tonus phase (viscoelastic)
3. limit of compliance (viscoelastic properties exhausted)
4. voiding (now considered to be in voiding phase!)



Voiding phase

Important to take note of following
- Opening pressure
- Pdet at Qmax
- Qmax
- Voiding time
- Shape of voiding curve
- Intermittent flow
  - (i) Poorly sustained bladder contraction (voiding curve follows Pdet with slight delay)

(ii) DSD (reciprocal relationship between voiding curve and Pdet secondary to isometric contraction)
(iii) Dysfunctional voiding (as for DSD but no urological disease)

Quality control

Calibration of pressure transducer, urine flow meter and water pump
Zero transducers at atmospheric pressure
Reference level at superior edge of symphysis pubis
Flush to exclude bubbles (otherwise cause damping)
Check for subtraction (cough, valsalva, fine detail)
If Pdet negative, either due to overly high rectal line pressure (ensure hole in rectal balloon), or air bubble in vesical line
Check feasible pressure values
Pves and Pabd

Supine	5-20 cm water
Sitting	15-40 cm water
Standing	30-60 cm water

Pdet 0-6 cm water in ~80% (artefactually occ. negative)
ICS defined fill-rates

Slow ("physiologic") fill	< 10 mL/min
Medium fill	10 to 100 mL/min
Rapid fill	> 100 mL/min

New ICS definitions of filling rate (weight in kg / 4 = x)

If rate <= x	physiological
If rate > x	non-physiological

Standard fill 50ml/m in warm saline. Slow fill if poor compliance suspected (neuropaths, high pressure chronic retention)
Avoid acidic and cold fluids – provoke unstable contractions
Regular coughs every minute
Empty PVR at time of catheterisation unless low compliance suspected (useful rule of thumb ~40% functional bladder capacity/voided volume – Chapple)
Always perform cough at end of voiding curve to ensure that line has not been voided into urethra

Diagnosis

Depends on state of detrusor and urethra during filling and voiding
'4 diagnoses of urodynamics'
- Filling
  - Detrusor overactivity
  - Urethral incompetence
- Voiding
  - Detrusor underactivity
  - Urethral obstruction

Reporting (3)

Describe filling phase (state of detrusor and urethra)
Describe voiding phase (state of detrusor and urethra)
Always describe whether symptoms were reproduced, partially reproduced, or not reproduced (failure to reproduce symptoms is not consistent with a diagnostic UDS study)

Complications

Urinary tract infection rates should be < 5%

Otherwise bleeding and discomfort – mild

Definitions (ICS)

Abdominal leak point pressure (ALPP)

The intravesical pressure at which urine leakage occurs because of increased abdominal pressure in the absence of a detrusor contraction.

Also known as valsalva leak point pressure (VLPP)

Measure of sphincter complex function (internal and external sphincter)

Patient upright, bladder filled with ~250ml; measured pressure is Pves.

Gives no information about detrusor function

Important in the investigation of stress urinary incontinence

VLPP

< 60 cm water	significant ISD
60 – 90 cm water	urethral hypermobility and ISD
> 90 cm water	urethral hypermobility alone

* NB continent women do not have a VLPP

Conflicting evidence that a low VLPP predicts failure after mid-urethral tape surgery however

Detrusor leak point pressure

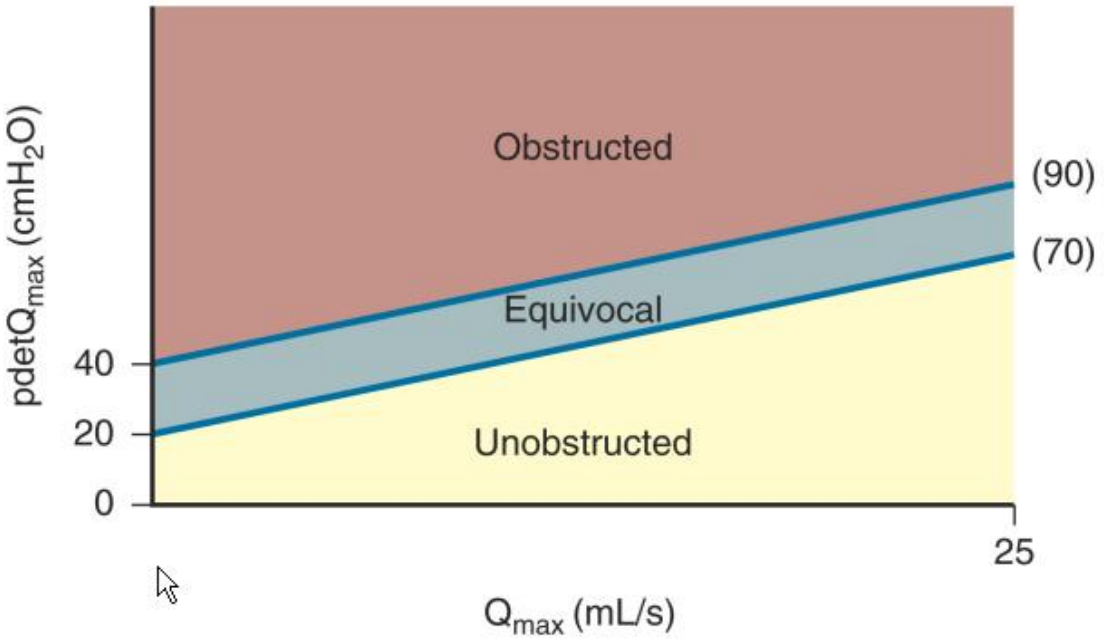
The lowest detrusor pressure at which urine leakage occurs in the absence of either a detrusor contraction or increased abdominal pressure

Originally described by McGuire in myelodysplasia patients with low compliance bladders

Gives an indication of fixed outlet resistance

DLPP > 40cm water a/w increased risk of upper tract dilatation and deterioration

ICS nomogram



Alternative nomogram by Werner Schafer, but ICS almost universally accepted

AG number

Pdet Qmax – 2Qmax

>40	obstructed
20-40	equivocal
<20	non-obstructed

NB. Specialised nomograms produced for women but not widely used (Blaivas and Groutz 2000)

Bladder contractility index

PdetQmax + 5Qmax

>150	strong contractility
100-150	normal contractility
<100	weak contractility

Adjunctive procedures

1. Provocation studies
    - Bethanecol test
        - Largely historical
        - Patients injected with subcutaneous bethanecol (parasympathomimetic); patients with intact pontine control show only mild Pdet increase cf. neuropaths
        - Only 76% sensitive and 50% specific
    - Ice-water test
        - Much more accurate
        - Ice water stimulates a strong spinal reflex, normally inhibited by higher control – causes raised Pdet and bladder emptying cf. normal patients
        - Sensitivity 97% for complete suprasacral spinal cord lesions, 91% for incomplete suprasacral lesions. Specificity ~100%

2. Video urodynamics
    - Determines the presence and location of obstruction
    - Determines significance of open bladder neck
    - Suggests DSD
    - Identifies VUR
    - Documents degree of bladder neck descent
3. Electromyography (EMG)
    - Co-ordination between external sphincter and bladder
    - 50-75mm through perineum towards apex of prostate in men
    - Smaller needle advanced 10-20mm parallel to urethra in females
    - Confirmation of DSD in neuropathic patients; in the absence of neurologic disease, findings termed dysfunctional voiding
4. Urethral pressure profiling
    - UP = fluid pressure required to just open a closed urethra
    - UPP = graph indicating changes in the intraluminal pressure along the length of the urethra
    - Thin water-filled catheter with side holes; mechanical puller at 0.5cm/s
    - May be performed static or during voiding. Voiding pressure profilometry performed to identify location of obstruction (pressure drop indicates level of obstruction – normal pressure drop 20-30cm along urethra in males. Females should be isobaric up to distal 1cm urethra
5. Ambulatory UDS
    - Physiological filling pressures reduced cf. conventional UDS
    - Increased sensitivity cf. conventional UDS for bladder overactivity
    - Difficult to determine true magnitude as incidence of asymptomatic phasic contractions higher (significance unknown)